6.16 YAGI-UDA ANTENNA

This antenna was developed by Prof. Yagi and Prof. Uda. It is an array ante which consists of one active element and a few parasitic elements. The act element consists of a folded dipole whose length is $\lambda/2$. The parasitic eleme consist of one reflector and a few directors. The length of the reflector is greater th $\lambda/2$. It is located behind the active element. The length of each director is less th $\lambda/2$ and they are placed in front of the active element. The spacing between ea element is not identical and hence it can be considered as a non-linear array. Th number of directions in the antenna depends on the gain requirements. Th impedance of the active element is resistive. The impedance of the reflector i

inductive. The impedances of the directors are capacitive. A typical structure of Yagi-Uda antenna is shown in Fig. 6.28.

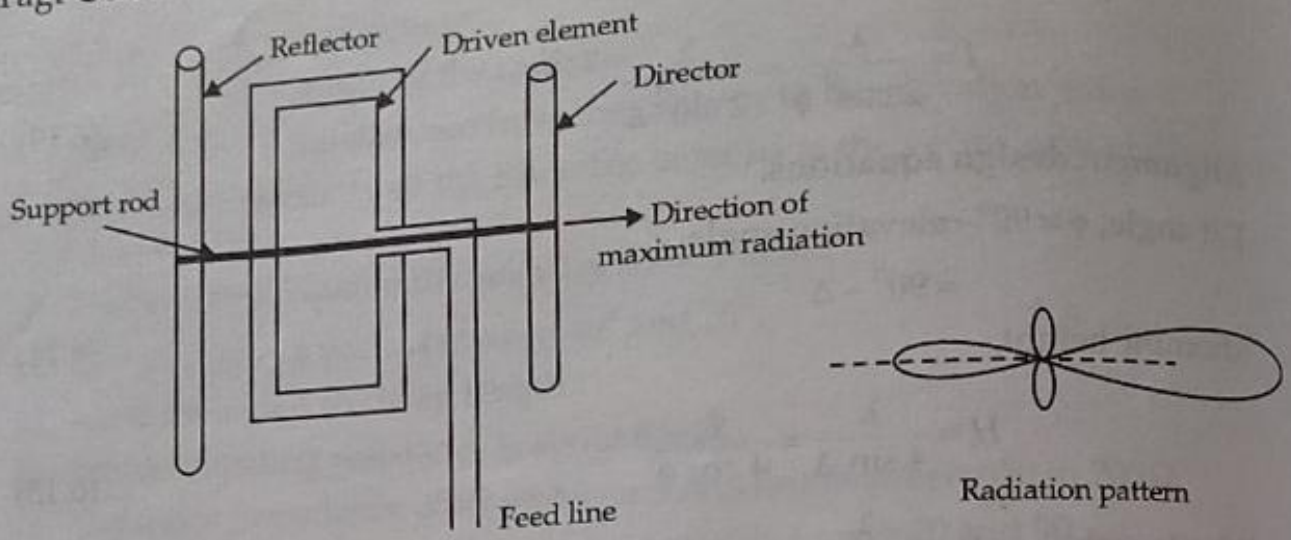

Fig. 6.28 *Yagi-Uda antenna and radiation pattern*

Salient features of Yagi-Uda antenna

1. It consists of a driven element, a reflector and one or more directors.
2. Driven element is usually a folded dipole which is excited. Director is a straight conductor placed in front of the driven element towards transmitter. Reflector is also a straight conductor placed behind the driven element.
3. Directors and reflector are called parasitic elements.
4. The length of the folded dipole is about $\frac{\lambda}{2}$ and it is at resonance. Length of the director is less than $\frac{\lambda}{2}$ and length of the reflector is greater than $\frac{\lambda}{2}$.
5. The optical equivalent of Yagi-Uda antenna is shown in Fig. 6.29.

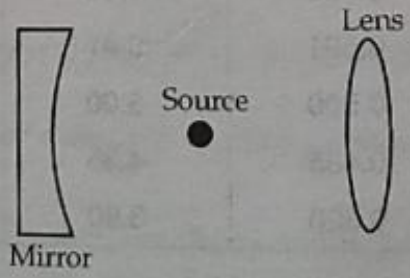

Fig. 6.29 *Optical equivalent of Yagi-Uda antenna*

6. Its radiation pattern is almost uni-directional and gives a gain of about 7 dB.
7. It is used as a transmitting antenna at HF and used for TV reception at VHF.
8. Back lobe can be reduced by bringing the elements closer. This reduces the input impedance of the antenna and hence there will be a mismatch.
9. The effect of parasitic elements depends on their distance and tuning. In other words, the effect depends on the magnitude and phase of the current induced in them.

10. Reflector resonates at a lower frequency and director resonates at a higher frequency compared to that of a driven element.
11. Folded dipole is used to obtain high impedance for proper matching between transmitter and free space.
12. More directors can be used to increase the gain. In this case, directors can be of equal length or decreasing slightly, away from the driven element. But adding too many directors will change the impedance.
13. It is relatively broadband because of the use of folded dipole.
14. Although it is compact, its gain is not high.
15. The purpose of reflector and directors is to increase the gain but they load the driven element.
16. The mutual impedance of the antenna depends on the spacing and the length of the elements.
17. Highest gain is obtained when the reflector is slightly greater than $\frac{\lambda}{2}$ in length and spaced at $\frac{\lambda}{4}$ from the driven element and when the length of the director is about 10% less than $\frac{\lambda}{2}$ with an optimal spacing of about $\frac{\lambda}{3}$.
18. It is possible to produce circular polarisation, when two Yagi-Uda antennas are placed across at right angles on the same boom, when the driven elements are fed in phase quadrature. The driven elements can be fed in phase by displacing one array by $\frac{\lambda}{4}$ along the boom with respect to the other.
19. The directors, whose lengths are shorter than the driven element, are characterised by capacitive reactance at the resonant frequency of the driven element.
20. The current which flows in the directors is the leading current.
21. The reflectors whose lengths are longer than the driven element are characterised by inductive reactance at the resonant frequency of the driven element.
22. Yagi-Uda antenna has exceptional sensitivity.
23. It has a good front-to-back ratio.
24. Its band width is limited.

Design Parameters The design parameters of six-element Yagi-Uda antenna which gives a directivity of about 12 dB_i at the centre of a band width of 10 percent of half-power are given by:

The length of driven active element,

0.46λ ...(6.17)